



# Noise and Missing ET

**Frank Chlebana**

**Marek Zielinski**

**LPC Conveners Meeting**

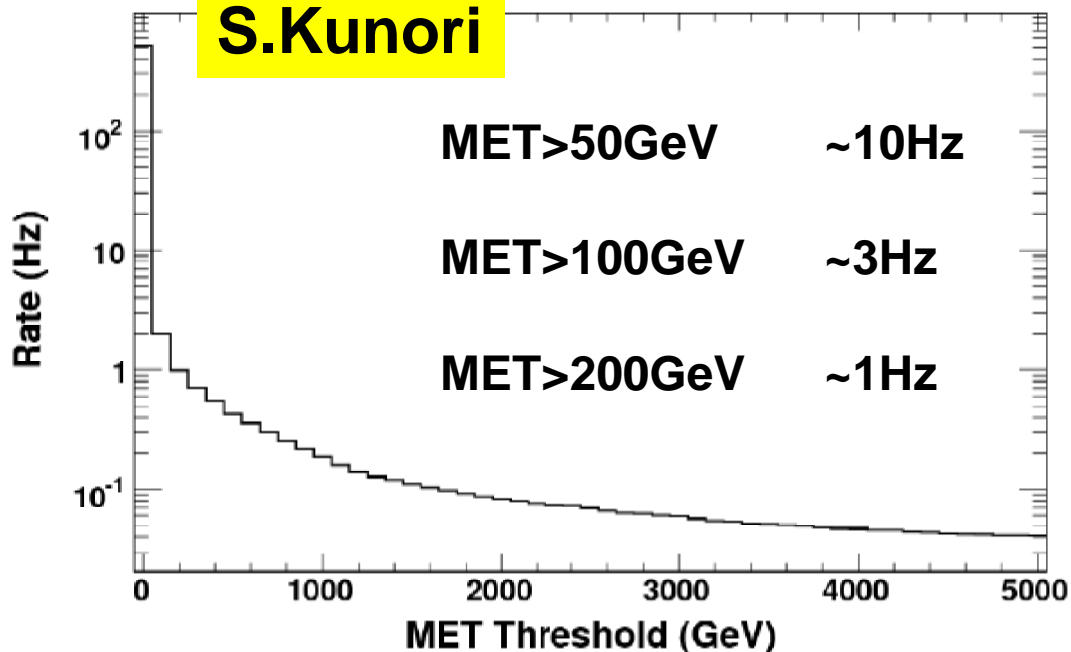
**Oct 3 2008**



# MET Rate



**S.Kunori**



**Run 51490**  
**(Muon+HCALtriggers)**

**Z( $\rightarrow$ nunu) + Njets**

**AlpGen Pt > 40 GeV sample**

**cross section\*Br (pb)**

**Z+1 parton 1039.8**

**Z+2 parton 314.7**

**Z+3 parton 79.8**

**Z+4 parton 18.5**

**Z+5 parton 4.0**



# Recent Presentations



## HCAL DPG Meeting Sunday Sep 21 2008

### Identifying Noise

Identifying discharge noise (*Amnon Harel*)

What we are learning from the data? (*Shuichi Kunori*)

Potential Bad Channels (*Luis Lebolo*)

HF Channels to keep an eye on (*Igor Vodopiyarov*)

### Identifying Problem Cells

DQM Status and Tools (*Jason St John*)

Prompt Analysis Tools (*Efe Yazgan*)

Common Ground with JetMET (*Chlebana*)

## Also presentations in other meetings...

HCAL ROC, Alfredo Gurrola, Ming Yan,

LatifeNukhetVergili, Taylan Yetkin, Warren Clarida



# Event Classification



Scanned events (run 51490) were classified into the following categories (*No machine related events yet*)

## RBX noise events

**12 Hz** for MET > 50 GeV

Entire readout box produces large rechit energies

## HPD noise events

**3 (1) Hz** for MET > 50 (100) GeV

Single HPD produces large rechit energies

## Muon/Air shower signal

**0.05 (0.01) Hz** for MET > 50 (100) GeV

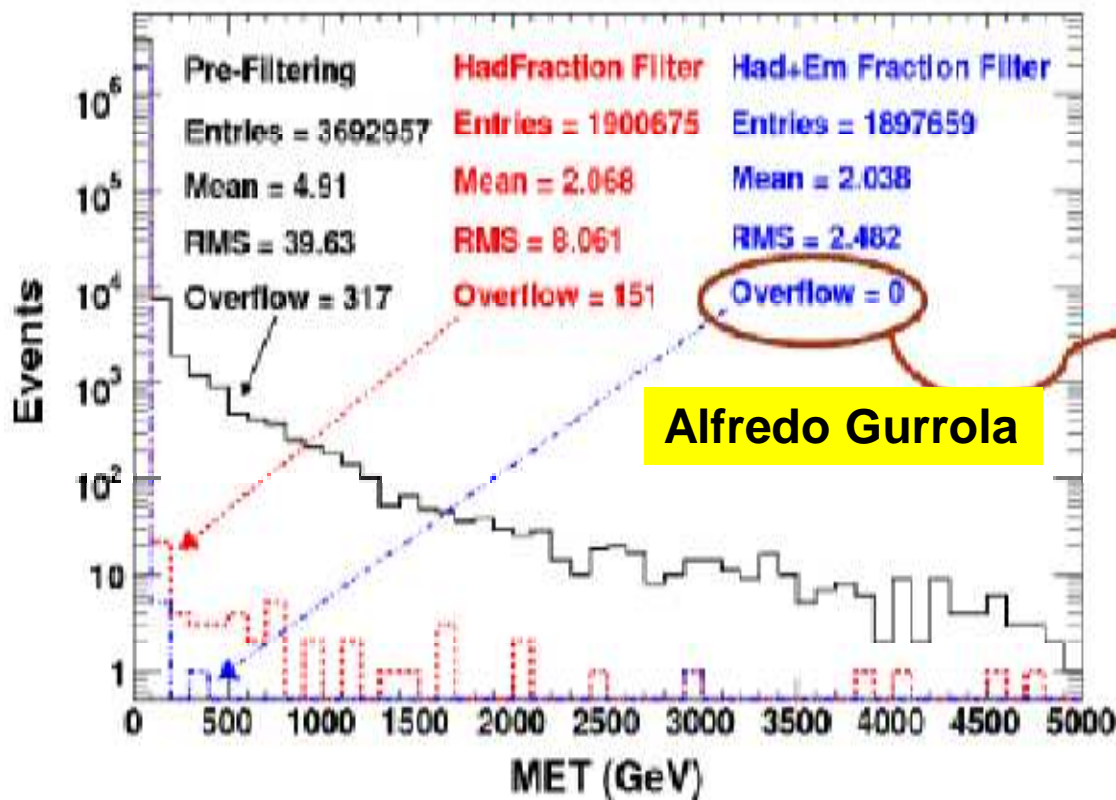
Real muon showers producing large rechit energies

## EB abnormal events

Noise in ECAL produces *huge* rechit energies

Above rates are very preliminary, and only for the 0T case  
We need 3.8T data and more careful analysis

**S.Kunori**



**MET > 200 GeV**

prefilter: **~1 Hz**  
 Had Filter: **0.026 Hz**  
 Had+EM Filter:  
**0.00055 Hz**

**Effective at suppressing noise triggers at the HLT**  
***More challenging to identify noise overlaid with signal...***



# Filter Algorithms



Investigating additional methods to identify/remove “noise” events, using:

## Hit pattern (energy or multiplicity) in eta-phi space

- RBX noises produce many hits in four RM in one RBX
- HPD noises are in one phi slice

See Ted Laird’s talk at MET working group meeting on 17-Jul-2008

<http://indico.cern.ch/conferenceDisplay.py?confId=37975>

## Hit pattern in HPD pixel space

- HPD noise tends to spread from one pixel to others

## Pulse shape

- Some noise events have longer tails or a pre-pulse

## Hit timing

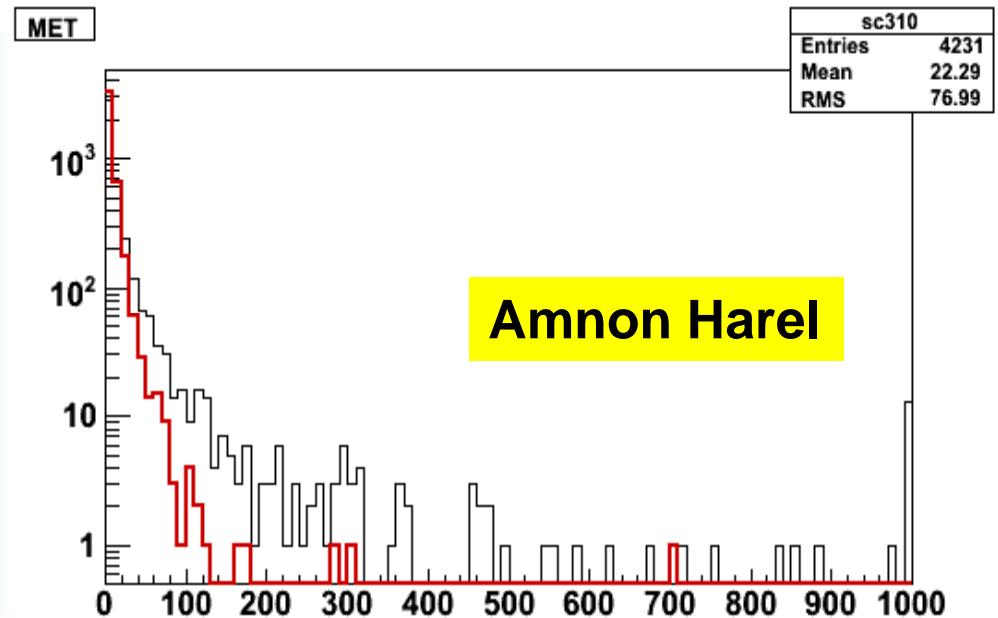
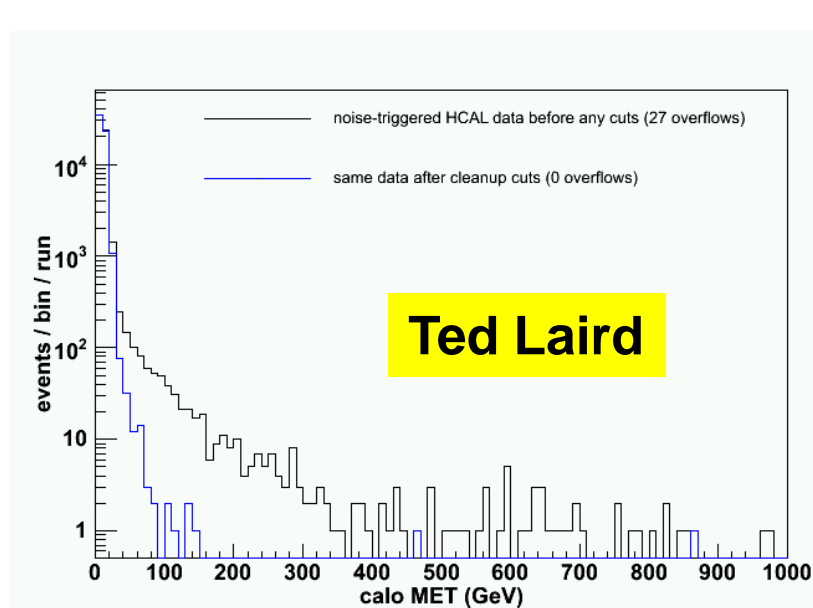
- Noise/cosmic events happen randomly w.r.t. the LHC clock

If necessary, some of these may be used in filter at HLT

**S.Kunori**



# Using Patterns to Identify Noise



Run 44763 (data)

MET (GeV) :	all	0-100	100-1000	1000+
before cuts :	60k	59667	306	27
after cuts :	~58k	58260	8	0

HPD discharge ID, using only HCAL energies CRUZET 3  
run 51203 (HPD noise trigger)



# Tools



## Identify run conditions, trigger

good run registry, run summary,  
word of mouth... *links changed (cmsmon)*

## Analysis job

example to access data and create histograms

## Event filter

write out file of events passing filter

</CMSSW/RecoJets/JetAnalyzers/doc/myJetAna.html>

## Event display

scan events (cmsShow)





# RBX and HPD Clustering



Cluster towers according to RBX and HPD geometry

## HPD Object

nTowers > 6  
total energy > 3 GeV  
time information?  
EM energy?

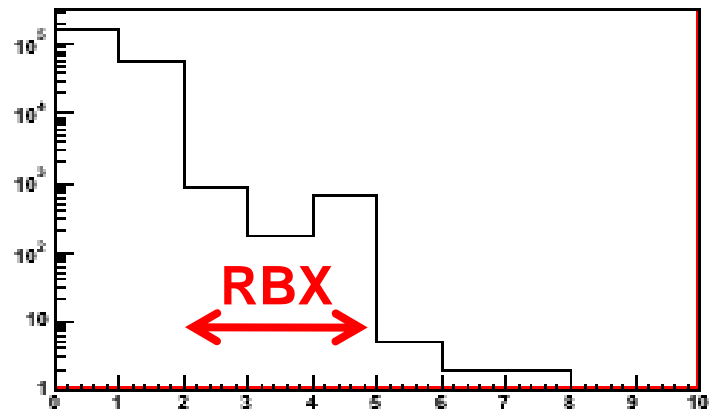
## RBX Object

nTowers > 24  
total energy > 3 GeV  
time information  
EM energy?

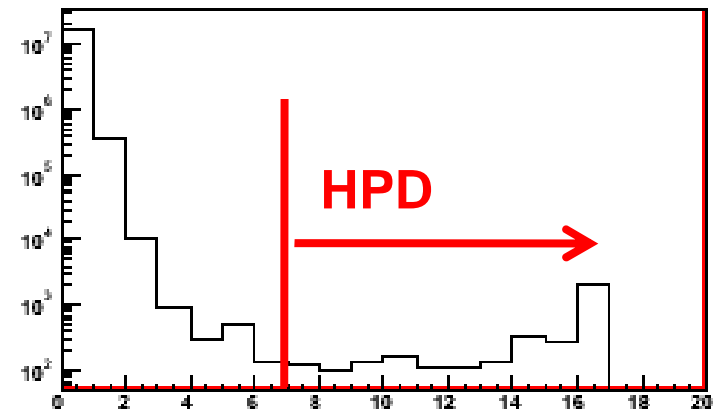
Tower has ET > 0.5 (*will change to energy threshold*)

*Looking at run 58600*

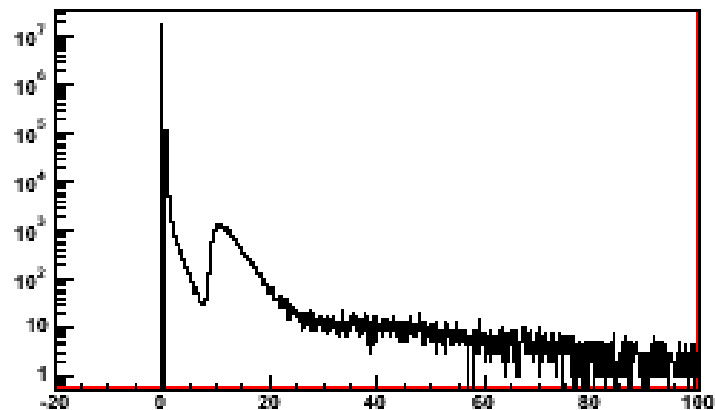
## Number of HPD



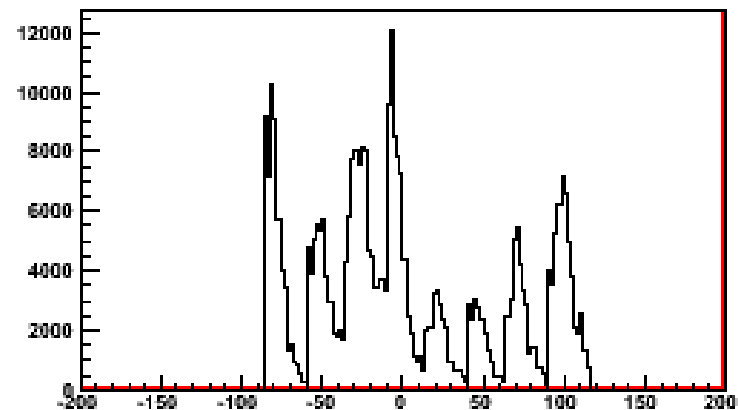
## Number of Towers in HPD

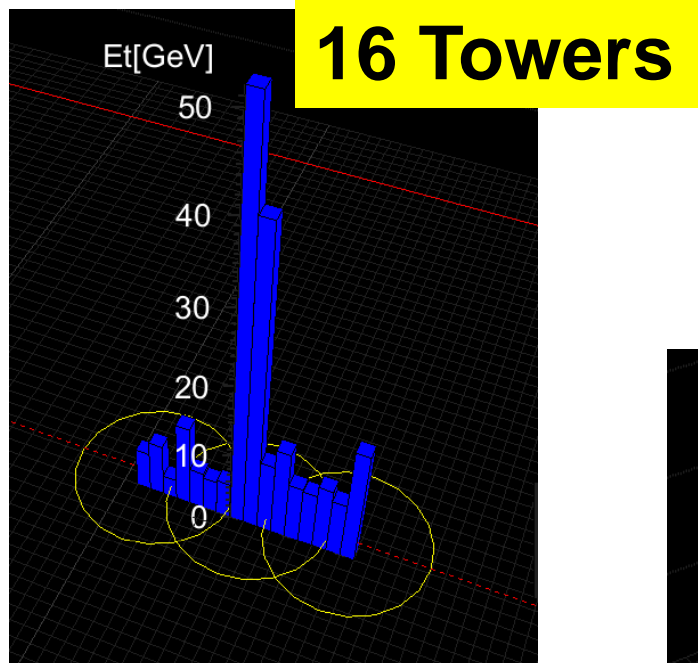


## HCAL Energy in HPD

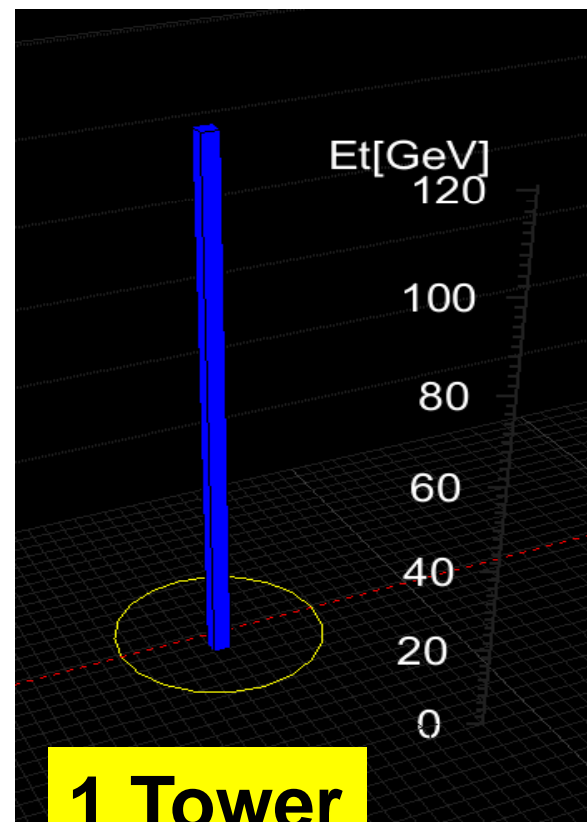
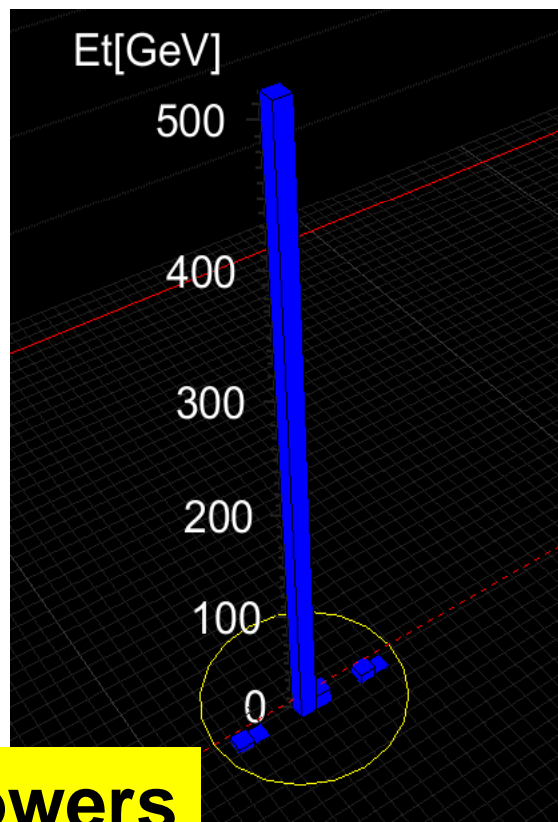


## HCAL Time in HPD





**Not “classified” as HPD**

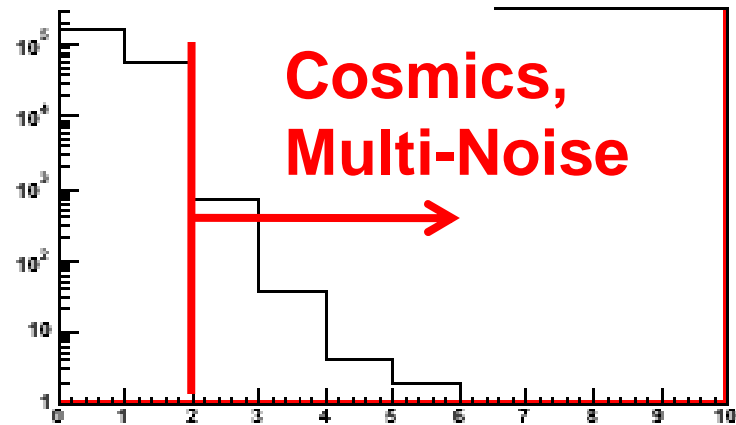




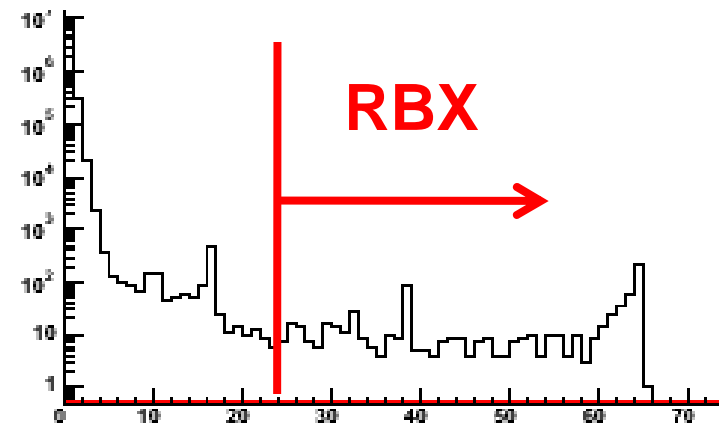
# RBX Characteristics



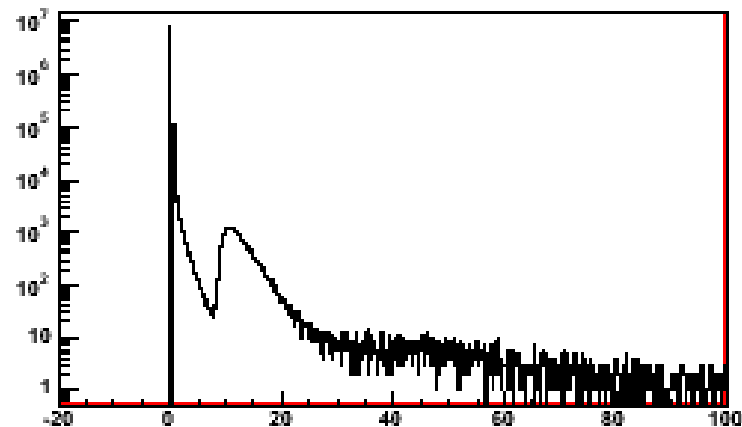
## Number of RBX



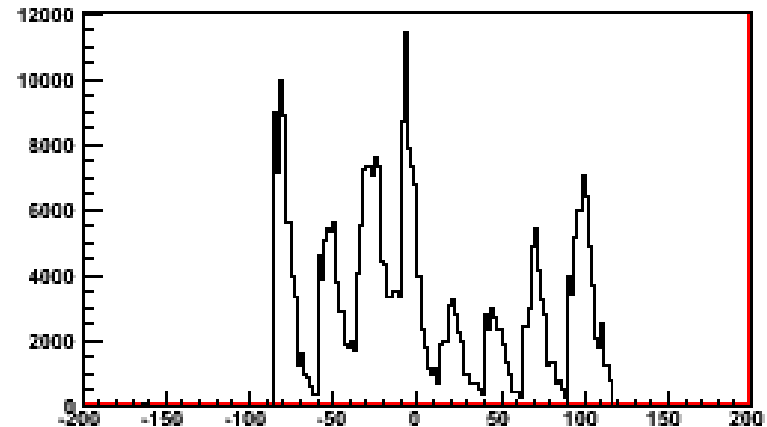
## Number of Towers in RBX

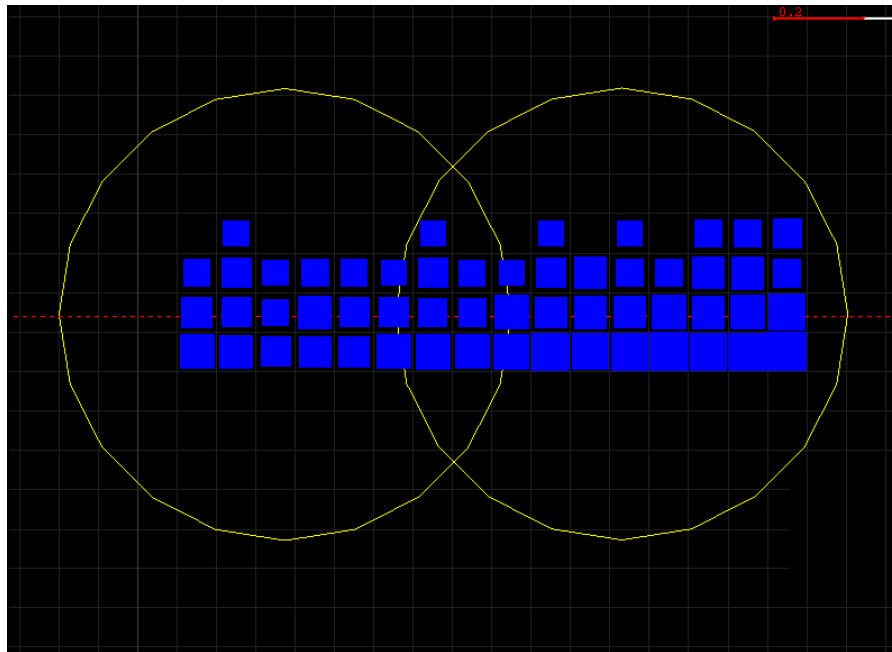


## HCAL Energy in RBX



## HCAL Time in RBX



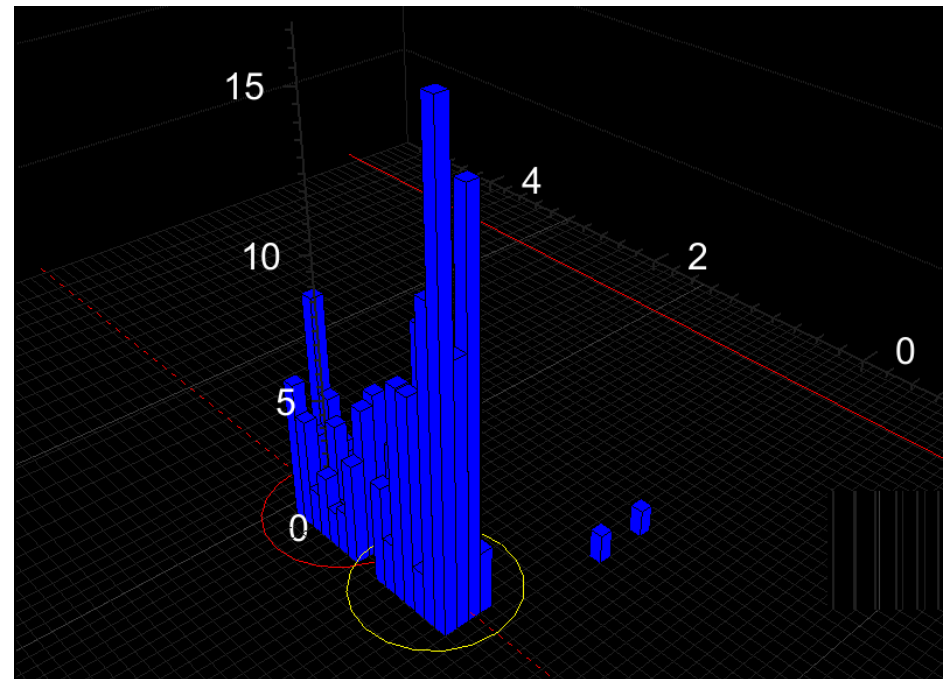


**RBX Noise:**

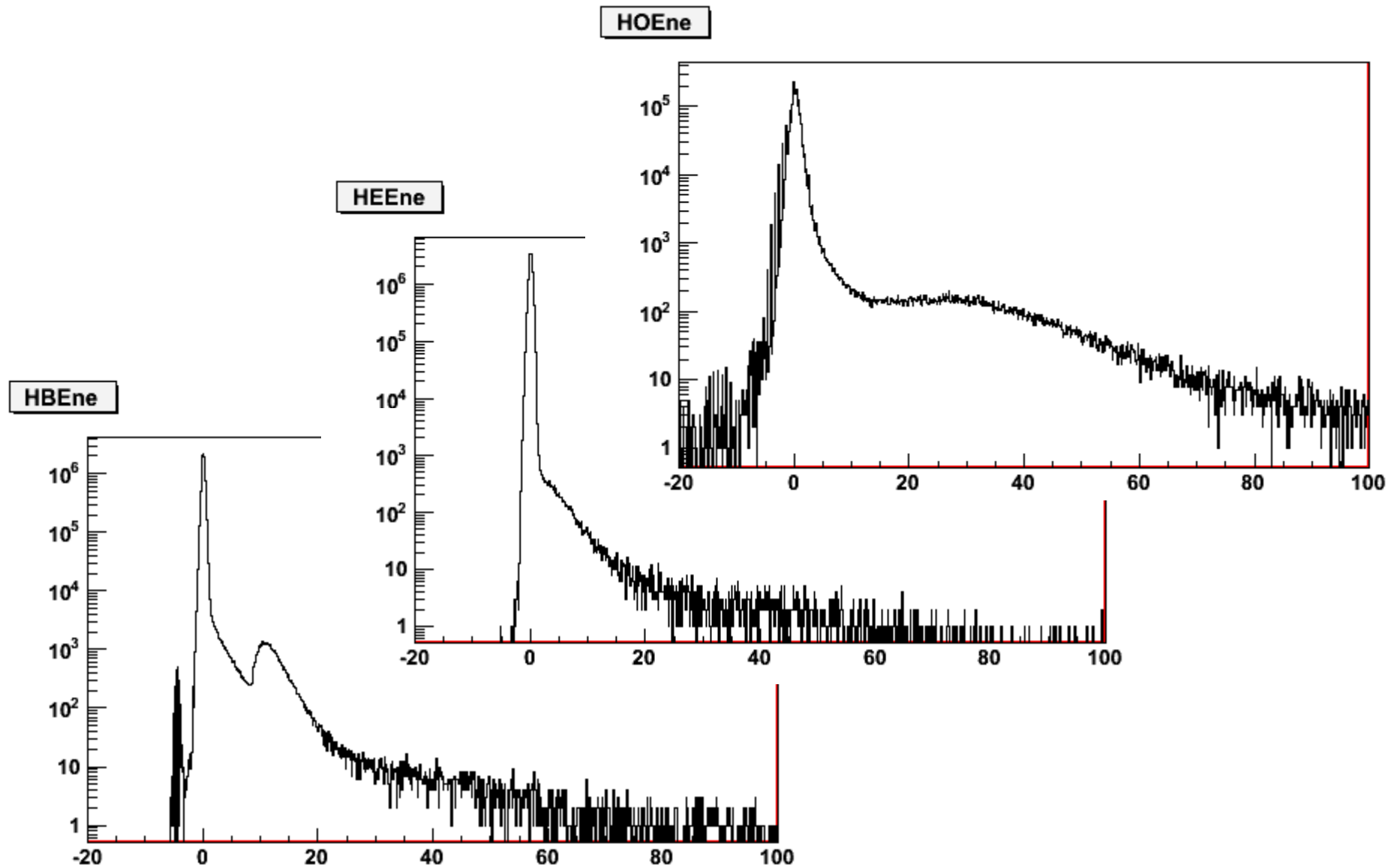
***Four adjacent HPDs***

**Will have same problem  
as for HPD**

***Number of towers falling  
below threshold...***



# HCAL RecHits

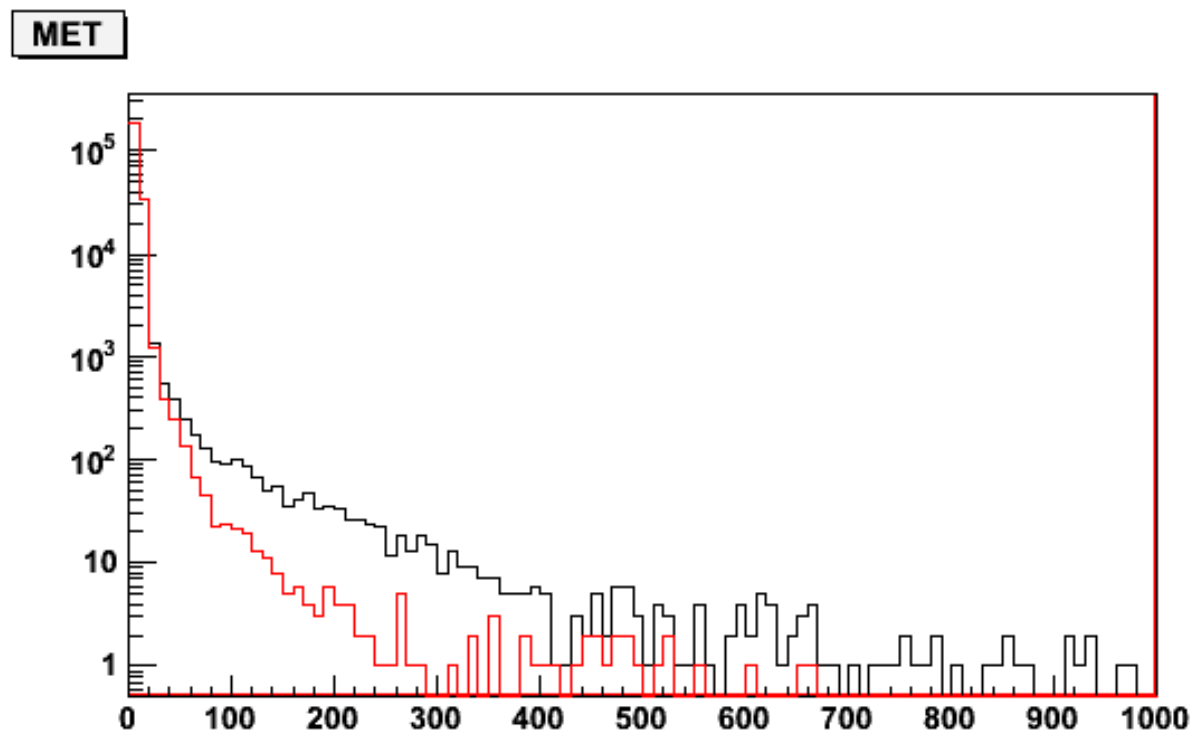




# Simple HPD and RBX Filter



After applying simple HPD and RBX filter

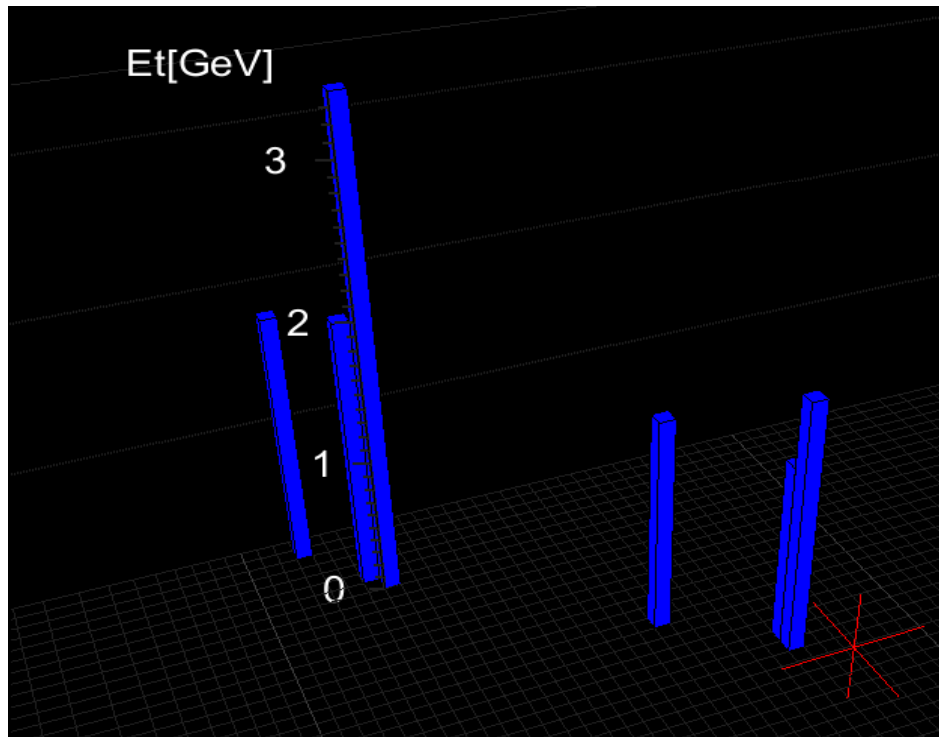




# Cosmic Background



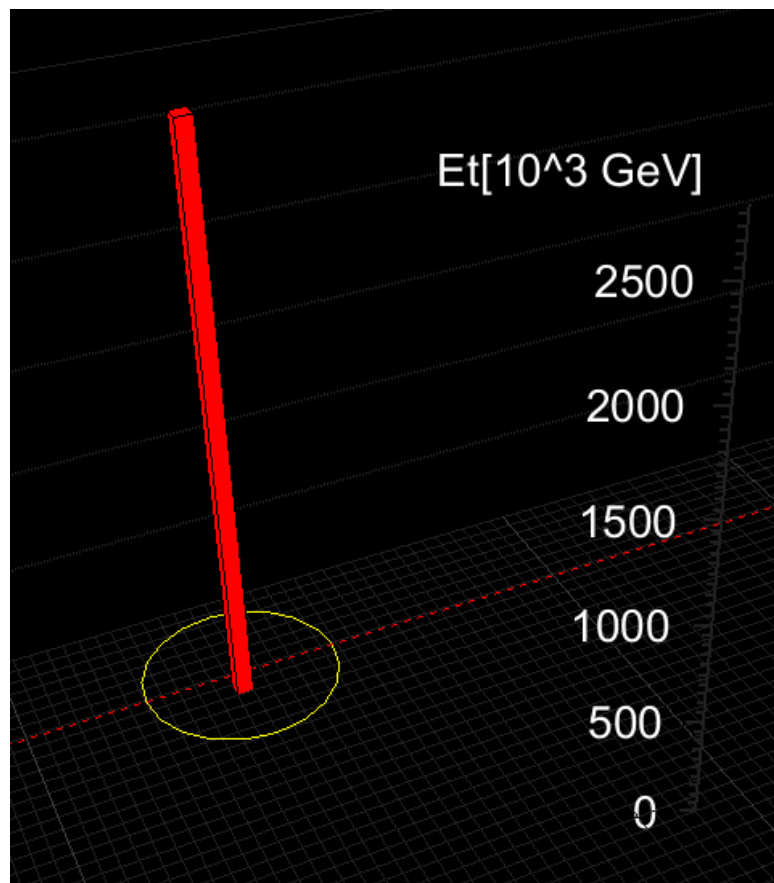
**Cosmic event having energy in several phi slices...**







# Huge “Energy” in EB

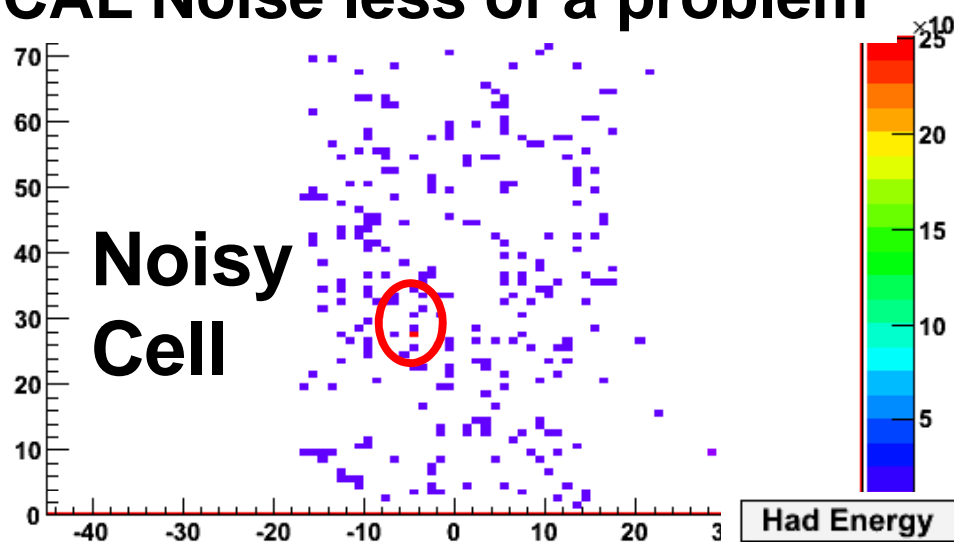




# Hot Spots and Dead Channels



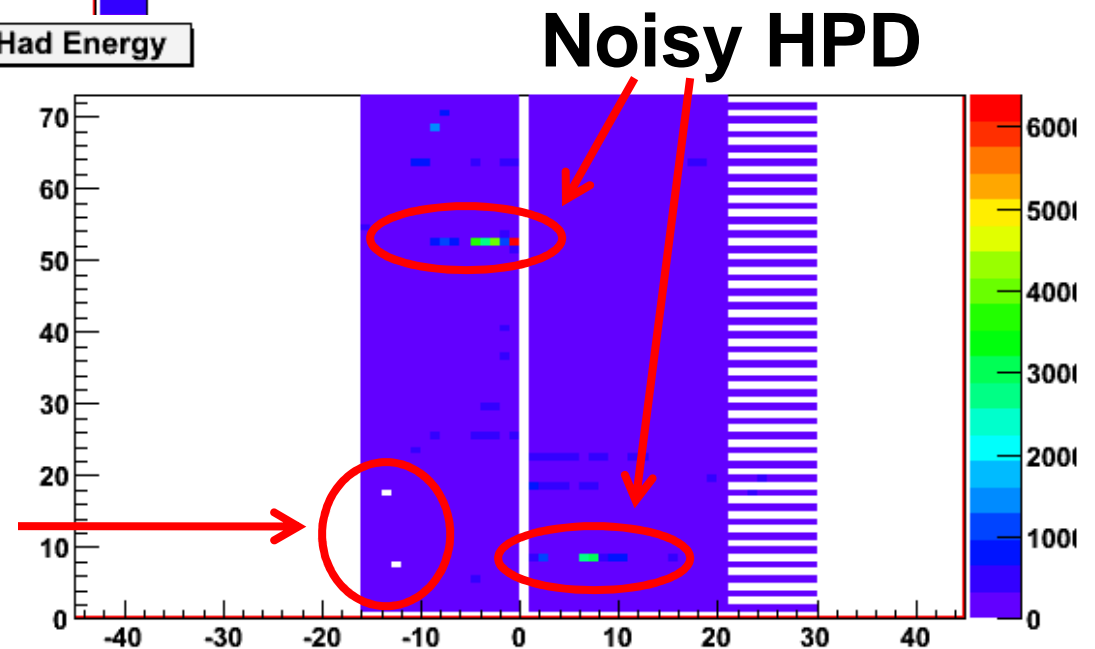
ECAL Noise less of a problem



DQM and prompt analysis will identify noisy channels

*Mark problem cells using CaloStatus Flag*

Dead or very quiet Cells





# Mixing Noise with MC Signal



Removing Noise in empty events is “easy”

*EM/HAD ratio is effective*

Challenge to remove noise overlaid on data

*Develop noise algorithm library*

*Use data mixer to mix noise data with MC signal (variables used for discrimination need to be well described: noise, timing...)*



# Summary



**DQM should identify potential noisy channels**

*Automate and test the procedure*

*Use CaloStatus Flag to mark problem cells*

**Several groups looking at noise**

*Produce a common noise algorithm library*

*Identify: HPD, RBX, cosmic, halo,...*

**Use Mixing Tool to overlay Noise with MC signal**

**Activity is well aligned with LPC interests**

***Great way to learn the tools of the trade...***